Costs of Pelleting Feeds at Selected Cooperative Feed Mills

by Lacey F. Rickey

Farmer Cooperative Service
U. S. DEPARTMENT OF AGRICULTURE
Washington, D. C.

FCS Bulletin 3

April 1954

(Formerly FCA Bulletin 63)

The Farmer Cooperative Service conducts research studies and service activities of assistance to farmers in connection with cooperatives engaged in marketing farm products, purchasing farm supplies, and supplying business services. The work of the Service relates to problems of management, organization, policies, merchandising, quality, costs, efficiency, financing, and membership.

The Service publishes the results of the studies; confers and advises with officials of farmers' cooperatives; and works with educational agencies, cooperatives, and others in the dissemination of information related to cooperative principles and practices.

Joseph G. Knapp
Administrator
Farmer Cooperative Service

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Senior Agricultural Economist

A Study Conducted With Funds Provided Under
the Agricultural Marketing Act of 1946

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(Originally published as Bulletin 63 by the Farm
Credit Administration - May 1951)

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SUMMARY

This report covers a study of the costs of pelleting feed at 14 cooperative feed mills located in various parts of the country. It includes only the additional costs due to pelleting and omits all consideration of general feed manufacturing expense.

The total annual volume of feed produced varied from 18,000 to 285,000 tons. The number of pellet machines operated by the 14 co-ops ranged from 1 to 10. The annual volume of pellets manufactured ranged from 3,600 tons to 90,000 tons.

Additions to general feed manufacturing costs chargeable to pelleting ranged from $1.09 to $2.43 per ton.

Many items had to be estimated on various bases but it is believed the total figure for each mill is sufficiently accurate to provide useful comparisons of cost.

The range in the different expense items per ton of pellets and the percentage of total costs each item in the average of all mills represented was as follows:

Expense items	Range	Percentage of total
Labor	$0.046 to $1.112	19.4
Power	.053 to .385	12.1
Steam	.100 to .350	10.4
Dies	.080 to .500	9.3
Repairs and maintenance	.050 to .217	8.1
Interest and depreciation on equipment	.250 to .920	26.3
Building occupancy	.075 to .191	7.1
General and administrative	.050 to .188	4.9
Extra warehousing	0 to .300	2.4

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Pelleting feeds consists of the mechanical application of pressure to livestock and poultry feeds so they assume and retain the shape of the die used in making the pellets. The manufactured feeds consist largely of more or less finely ground grain carefully combined with proteins, minerals, and vitamins so as to constitute complete balanced animal rations.

There is no clear-cut evidence that pelleting adds to the nutritive value of feeds, but the reduction of various feed losses and the saving of labor on the farm appear to justify the maintenance or expansion of this operation while the Nation is struggling to better its defenses.

With the constantly increased demand for pellets, the costs to the mills of making them assume added importance. While cooperative feed mills provide pellets as a service to their members, with the charge governed somewhat by competition in the area, these mills want each operation to carry its part of the load in justice to both those who do and who do not use this particular service. Consequently the Cooperative Research and Service Division has had many inquiries concerning these costs. In view of the small amount of information available, the Division was requested to make a study of representative cooperative feed mills to determine their pelleting costs, to find where and why these costs are high, and to suggest factors to be watched in order to reduce them. The Feed Advisory Committee appointed by the Secretary of Agriculture under the Research and Marketing Act approved this study as one to be carried out

NOTE: The author is grateful to the managers and other employees of the mills included in this study. They gave their time freely to provide data and answer questions. Dr. Joseph G. Knapp, now Administrator, Farmer Cooperative Service, and Dr. Martin A. Abrahamsen, now Chief, Farm Supplies Branch, and other members of the staff gave helpful suggestions. Eugene G. Grab, Agricultural Engineer, assisted with engineering phases.

under the general project on costs and margins in feed manufacturing.[1] This study was made during 1949 and early 1950. Since then many of the items of pelleting costs have increased and this will have to be taken into consideration in judging current costs.

Pelleting is so integrated with other feed-mill operations that few managers have made any serious attempt to find how much this additional processing actually costs. During World War II the Office of Price Administration settled on $1.50 per ton as a permissible charge for this operation. Many feed manufacturers contend this was not sufficient.

The additional charge made for pelleted feeds varies greatly at the present time. One mill studied sold pellets at the same price as the corresponding mash. This, however, was because member associations through which the feed was distributed approved this method since it avoided the necessity of two different prices. Generally the pelleting charge varies from $1 to $2.40 per ton. A majority of the mills now make a charge of $2 per ton with $1.50 per ton the next most common amount.

In many cases the charge for chick size pellets (8/64 or 9/64 of an inch in diameter) is more than for the larger sizes because the mills turn them out more slowly. Many mills have discontinued these small pellets and instead make a laying size pellet and crack these into "crumbles" for chick feeds. Where range cubes are important, the charge for these large pellets (½ to ¾ of an inch) is often lower because they run through the machines rather fast.

[1] A previous report under this project was *"Operating Costs of Selected Cooperative Feed Mills and Distributors,"* Farm Credit Admin. Bul. 56, 1949. 87 pages.

Why Feeds Are Pelleted

The arguments usually advanced in favor of pelleted feeds are:

1. *Wind loss reduced.*—When ground feed is placed in hoppers or bunkers on the range, strong winds will carry away varying amounts. Turkey and cattle feeders, particularly, find this problem is substantially eliminated by the use of pelleted feeds.

2. *"Billing" is avoided.*—Poultry will pull out of hoppers with their bills substantial amounts of ground feeds, which fall to the ground and are largely lost. Pellets are much less likely to be pulled out in this way and, if they are, will usually be picked up by the poultry. Ground feed sticks to ducks' bills. After each "bite" they go to the water and part of the feed is washed off and lost. Considerable feed also sticks to turkeys' bills. They "wipe" it off and this is lost. These losses are practically eliminated by using pellets.

3. *Each bite a balanced ration.*—It is contended that some hens will pick out from the mash the large particles or particles of a cer-

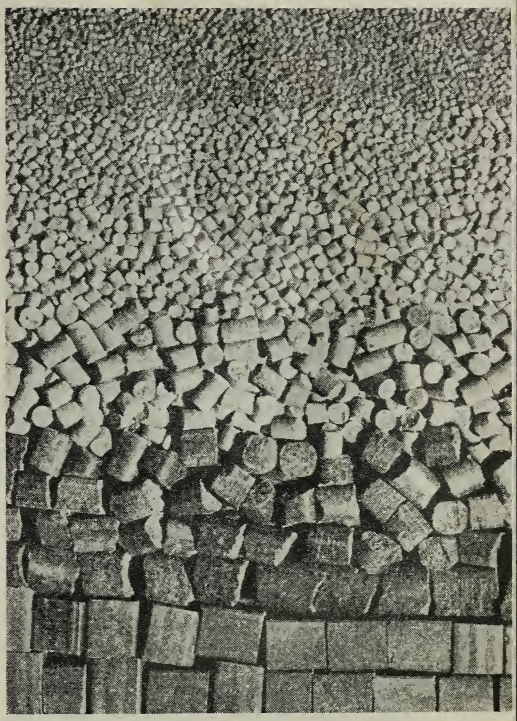
tain color and hence not get a balanced ration. Likewise, the wind loss mentioned will remove from a feed greater proportions of some ingredients than of others and destroy the nutritional balance. Each pellet made from a well mixed mash will contain a proportionate part of each ingredient used in making the feed and hence each hen will receive the same ration.

4. *Less crowding.*—Hens will pick up a given amount of pelleted feed from the hoppers in less time than an equivalent amount of mash. Hence, there will be less crowding at the hoppers. The more timid hens will have a better opportunity to get up to the hoppers for their feed.

5. *Added feed intake.*—A heavy rate of egg laying requires the consumption of large amounts of feed. Feed intake of laying flocks can often be increased by having the mash hoppers open at all times and feeding a "lunch" of pellets toward evening, either on top of the mash in the hoppers or on the ground or litter.

6. *Labor saving.*—Pellets are easier to handle in many ways than loose feed. On the farm this often means a large saving in the amount of labor involved in feeding.

7. *Dust control.*—Certain powdery ingredients, like alfalfa meal, can be handled with much less dust when in pellet form. The pellets can also be shipped and handled in bulk more readily. Many feed mills now receive and store their alfalfa meal requirements in bulk pellet form and regrind them as needed for mixing in formula feeds.



Feed pellets are made in many sizes. The smallest are used for chick starter or game birds. Laying mash pellets are usually 12/64 or 13/64 inch in diameter. Hog feeds are 3/8 inch. Sizes 1/2 to 3/4 inch are mainly for sheep or cattle feeding.

Experimental measurement of the economy of feeding pellets has been rather inconclusive. There is evidence that the laying flocks' body weight is increased but egg production is little affected. Research is now under way which should provide more conclusive information as to wind and other losses as well as actual nutritional results.

Even with inconclusive evidence as to dollar and cents economy, farmers have steadily increased their demands for pelleted feeds. Convenience and ease of handling are often determining factors. Duck

and turkey raisers are almost unanimously in favor of pellets. Winter feeding of range cattle and sheep provides many reasons for using large size pellets or "cubes". Feeders of hogs and poultry have turned in increasing numbers to feeding pellets as a regular practice.

As a result, many feed mill managers who have never been convinced that the use of pellets is justified economically have been forced by the demands of their patrons to install pellet mills. Feed mills which installed one or two pellet machines a few years ago have had to double or triple their pelleting capacity.

Since the study is intended to help determine the equitable charge to be made for pellets over that for the same feed in unpelletd form, only the extra costs involved in this operation are considered.

How Pellets Are Made

In making pelleted feeds the process is the same as for loose feeds up to the point where they would normally be sacked for distribution. Here the mixed feed is diverted to holding bins from which the pellet mills are fed. Usually the pelleted feeds are made from exactly the same formulas as the corresponding loose feeds, although in a few instances slight variations are made to meet particular conditions.

Pelleting is facilitated by "conditioning" the dry feed with steam. This is accomplished by introducing steam into the feed in a small mixer provided as an integral part of the pellet mill. This conditioning helps to make a hard pellet which will not break up easily and, probably because of a lubricating action of the moisture, also increases the output of the mills. While steam is used primarily for this reason, some claims are made that the heat and moisture also increase the nutritive value.

From the conditioning unit, an adjustable feeder regulates the flow to the pellet mill proper. In the mill, heavy steel dies are provided having holes the size of the pellets to be made. The feed is forced through these holes under great pressure by rolls. It comes out as hard, glossy cylinders which are broken off by adjustable knives set to give the desired length of pellet.

The pressure of these rolls generates considerable heat. This drives off the moisture carried by the steam which was used in conditioning. Tests run at some of these mills at the request of the author showed that the variation in moisture content between the dry feed before conditioning and pellets made from the same batch of feed was seldom more than two-tenths or three-tenths of 1 percent. This variation was under about as often as over the original moisture content. Some mills add a fraction of a pound to each bag of pellets since they find that cooling and drying

continue after the feed has been sacked. The pellets must be cooled before they are sacked. This is usually accomplished in coolers made for this particular purpose, through which the pellets pass slowly while cool air is drawn around them by powerful fans. "Fines" are removed by a shaker screen either before or after passing through the cooler and these are returned to the pellet mill. The pellets may be sacked off directly from the cooler, but in most cases efficiency is increased if there are holding or "surge" bins between cooler and sacking scale.

Factors Affecting Costs of Pelleting

Labor

Pellet mills do not require the constant attention of an operator. Once the rate at which the feed is supplied to the mill is set and the steam supply properly adjusted, little attention is needed. An occasional glance at the ammeter will show the electric current being used and hence how near to capacity the mill is operating. Looking at and feeling some of the pellets coming from the machine tells the operator a great deal. The operator also must see that the bins from which the mills are supplied do not run empty. When there is a small number of mills in a battery, these duties can be performed by a man sacking off the finished pellets or doing other work in the vicinity of the mills.

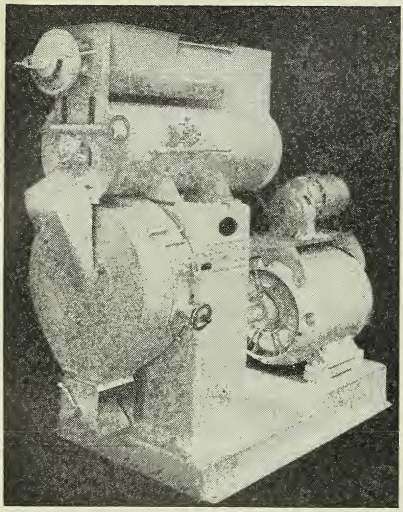
Another labor item is that of changing dies. This will take one or two men from 30 minutes to over an hour each time. The number of changes varies greatly. Some feed mills can put a die on and run it until worn out. Others have to change frequently in order to meet the demand for pellets of different sizes. If these changes are made by labor not regularly engaged in the pelleting operation, their time has been added in this study in determining labor costs.

Sacking the finished pellets is often the greatest use of labor to be charged against pelleting. The attempt in this study is to determine the additional cost of pellets over the same feed in mash form. The mash itself must be sacked; so only when sacking pellets is slower than sacking mash in the same plant was any charge made. In many feed mills pellets and mash will be weighed and sacked over the same or similar units operating at the same rate. If so, no charge to pelleting is made in the study. But in many plants pellet sacking is

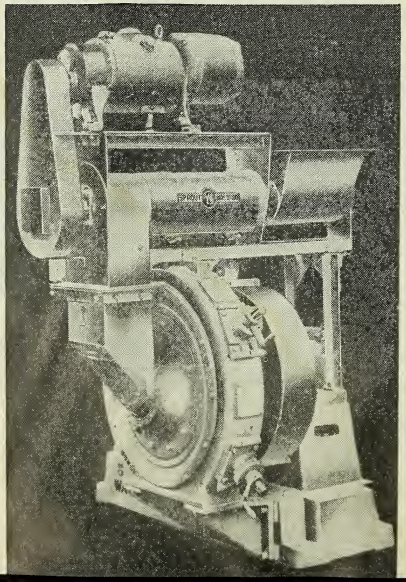
Pelleted feeds appeal to farmers because they are clean and convenient to handle. Under many conditions less feed will be lost or wasted.

slower. This is especially true when the pellets are sacked direct from the cooler, rather than accumulating them in bins until a run can be made at the regular operating rate of scale and sewing machine.

For instance, if mash in a batch mill is weighed, sacked and the bags sewn by one man at the rate of six bags per minute while the pellet set-up permits a man to handle only two bags per minute, the difference is charged as a pelleting cost.



Two modern pellet mills. Motors are usually direct connected but sometimes have a multiple V-belt drive.



In general, a battery of several pellet mills can be operated more economically than one or two mills. Likewise, the latest model mills produce about twice the volume of most older models and therefore lower many of the cost items.

The hourly rate of pay for men on the pellet mills was obtained at each plant. If a mill was operated regularly more than 40 hours a week, the overtime rate was also used in calculating an average. At most mills 15 percent was added to cover labor taxes, vacations, retirement plans, and other items of labor cost. In cases where the mill had calculated a loading charge to wages for these items its figure was used.

In mills where certain men regularly worked full time making pellets, production and other data on an annual basis were used, or in some cases for a 3-month or 6-month period. Where this was not possible, spot time studies were used in connection with short-time production and other records.

Power

Power is one of the larger items of cost in making pellets. Each pellet mill is driven by an individual electric motor. Those covered in this study varied from 30 to 75 horsepower and operated generally on 440-volt current, although two mills used 220-volt current and one 550 volt.

Charges for electric current for such industrial operations are usually based on a "demand" charge and an "energy" charge. The "demand" charge is related to the greatest amount of current used at any one time. The "energy" charge is made on a sliding scale based on kilowatt-hours used, with cost of fuel introduced as a varying factor in some instances. In order to get an average charge per kilowatt-hour for current used, monthly power bills were divided by the kilowatt-hours shown. Each pellet mill motor has an ammeter showing the amount of current being used so the operator can keep it running close to full capacity. With the average cost of current per kilowatt-hour, an average reading of the ammeter and the voltage at which the current is supplied, the cost per hour of operation is easily calculated. This involves the simple formula of volts $\times$amperes=watts. A kilowatt is of course merely 1,000 watts. Charges for current are based on kilowatt-hours.

In addition to the motor driving the mill, there is a small one on the conditioner, one or two on the cooler, another on the "shaker," and whatever are needed to drive elevators and conveyors handling material to and from the mill. The total horsepower of these motors ranges from 20 to 50 percent of the power used on the mill itself. Cost of current used by these motors was calculated on the assumption that the ratio to cost of current used by the large pellet machine motor was the same as the ratio of their total horsepower to that of the large motor. With this cost per hour of all power used in the pelleting operation, the cost per ton was determined.

Steam

Some feed mills, in addition to using steam to condition mash that is to be made into pellets, use it in rolling barley, for warming molasses, and heating buildings. The boilers are fired with oil or gas. The principal components of steam cost are fuel and depreciation on boiler equipment. Maintenance and labor are smaller items. At only a few of the mills was it possible to get accurate cost figures for the steam used in pelleting. At others, this cost was estimated, using as many factors as could be separated.

Dies

The heavy steel dies through which the feed is forced to form the pellets are expensive. Those used in the mills studied varied in cost from $195 to $320. The life of these dies varied greatly at different mills—from as low as 600 tons to nearly 3,000. One mill has records on dies used over a period of 8 years which worked out to an average cost of 8 cents per ton. Others had records for shorter periods and at some it was necessary to use estimates of the manager or superintendent. The prices used were usually those for the last dies purchased. Die prices have recently been raised and costs per ton have increased accordingly.

There are unavoidable variations in the steel used and in the harden-

ing process, which affect the life of the dies. The amount of steam used is probably a factor. The life would vary with different feeds. There is a feeling that grain from dry, windy areas may have very fine particles of imbedded sand which cut the dies. Some of the mineral ingredients, such as calcium carbonate and salt, are hard and sharp and have an abrasive effect.

The manufacturers of pellet machines find consistent geographical variations in die life but no pattern that appears to provide a satisfactory explanation as to the reason. When the surface of a die begins to break down, some feed mills follow the practice of having them resurfaced and rehardened. Others find this to be hardly worth while.

The rollers which force the feed through the dies are also subject to considerable wear and are costly to replace. In this study they were included under maintenance and repair. In view of the fact that at some of the mills the cost per ton of feed for these rolls approached half the cost of dies, it appears that records on rolls should be kept separately or in connection with the records on dies used.

Maintenance and Repairs

Rolls and other replacement parts are included in this category as well as labor used in making necessary repairs. At many of the mills this account covered the entire plant and it was necessary to estimate the amount applicable to pelleting equipment. At some plants steam from the hot pellets rusted out elevators and conveyors rather rapidly. At others, this condition has been bettered by using rust resistant materials, more ventilation, or in some cases by handling the pellets with a pneumatic system. This item applies only to machinery and equipment. Building maintenance is provided for under "Building Occupancy."

Interest and Depreciation on Equipment

Rather than calculate interest on the depreciated value of each piece of equipment, an average value for the life of the equipment was used; in other words, half of the original value, installed. A uniform rate of 5 percent interest was used. Depreciation was calculated at a straight 10 percent on the original cost of the equipment, installed. Bagging scales, bag sewing machines, etc., were not included since they would be required for the same feed in mash form. The pellet mills and their auxiliary equipment were included, together with conveyors from the mash mixer and bins used especially for the pelleting operation. This was worked out in full detail for several of the mills and estimated from this background for the others.

Building Occupancy

An annual charge was estimated for use of building space used for the pelleting operation. This does not include any warehouse space. Space used by pellet bins was considered but no charge made here for the bins themselves, which were included as equipment. This charge

is intended to cover interest, depreciation, maintenance, insurance, and similar charges.

General and Administrative

No satisfactory method was found for determining how much of these expenses applied to the pelleting operation as such. In lieu of a better formula the amount per ton for these expenses for the total volume of feed was taken from operating statements, and one-tenth of this amount per ton was added to the pelleting costs. For instance, if general and administrative expenses amounted to 75 cents per ton for all feed handled by the mill, 7½ cents per ton was assumed to be applicable to pelleting. This general classification does not always cover the same expenses in different mills, and in the interest of uniformity, some adjustments were made.

Extra Warehousing

Often a larger percentage of pellets than of regular feeds must be warehoused. In order to supply current demands for small volume feeds, it is frequently cheaper to stock a fair volume of pellets than run small batches or change the size of die in the mill. Instead of trying to establish the actual cost of handling feed into and out of the warehouse over the cost of direct loading on cars or trucks at each mill, an estimated flat charge of $1 extra per ton was used. Thus, if 10 percent of the loose feed was stopped in the warehouse at a cost of $1 per ton, this would be 10 cents per ton on the total volume of loose feed. If 40 percent of the pellets had to be warehoused for a short time, this would add 40 cents per ton to the total pellet volume. The difference of 30 cents per ton is included as one of the items making up the difference in cost of making mash and pellets. In many of the mills there appeared to be no significant difference in this handling of mash and pellets.

Bag Size Differential

One item which has not been taken into consideration in determining pelleting costs is the fact that 100 pounds of good hard pellets will pack into a smaller bag than 100 pounds of the loose feed from which they were made. The usual burlap feed bag is made from a roll of burlap 40 inches wide. For most feed bags this is cut into lengths of from 42 inches to 52 inches. These pieces are doubled and sewed down one side and across the bottom and then turned so that the seam is inside the bag.

Several of the mills used bags cut 46 inches for mash but used the 44-inch cut for pellets. If the pellets are a little soft, this reduction in volume is not attained.

At the time this study was made the difference in the cost of bags made from 10-ounce burlap cut 44 inches or cut 46 inches was approximately $12.50 per 1,000. This would amount to 25 cents for the 20 bags used for a ton of feed if all new bags are used. Mills which follow a bag-return program usually allow patrons the same amount irrespective of size of bag. The actual difference in cost per ton

Table 1.—General mill data and pelleting costs per ton

Mill data							Costs per ton for pelleting									
Mill No.	Total annual feed production	Annual production pellets	Number of pellet machines	Pellet production per hour	Average life of dies	Base wage rate	Labor	Power	Steam	Dies	Repairs and maintenance	Interest and depreciation on equipment	Building occupancy	General and administrative	Extra warehousing	Total
	Tons	*Tons*		*Tons*	*Tons*											
1A [1]	285,000	28,000	3	6.9	2,500	$1.325	$0.971	$0.340	$0.180	$0.080	$0.175	$0.416	$0.147	$0.059		$2.368
1B [2]	285,000	28,000	3	6.3	2,500	1.395	1.112	.340	.180	.080	.175	.455	.161	.065		2.568
2A	90,000	10,000	4	7.5	2,700	1.450	.481	.241	.200	.100	.050	.920	.191	.050	$0.200	2.433
2B [3]	90,000	20,000	4	7.5	2,700	1.450	.433	.225	.175	.100	.040	.460	.096	.035	.150	1.714
3	75,000	8,400	2	4.0	1,200	.950	.468	.186	.210	.191	.050	.281	.075	.060		1.521
4	50,000	9,200	4	8.0	2,200	1.050	.251	.250	.250	.088	.150	.250	.100	.170	.150	1.659
5	18,000	3,600	1	1.6	1,200	1.015	.150	.263	.200	.161	.150	.278	.120	.085		1.407
6	38,000	5,000	2	6.5	1,000	1.150	.223	.190	.200	.220	.150	.550	.144	.080		1.757
7	62,000	11,000	2	6.0	750	1.575	.174	.159	.164	.293	.217	.424	.125	.074		1.630
8	30,000	8,000	2	6.0	600	1.350	.125	.125	.350	.500	.175	.375	.150	.180		1.980
9	140,000	13,600	4	15.0	1,800	1.550	.152	.053	.200	.164	.180	.525	.135	.100		1.509
10	50,000	5,000	1	2.5	2,000	1.200	.351	.237	.200	.145	.150	.349	.100	.188	.300	2.020
11	40,000	4,000	1	3.0	2,000	1.200	.453	.385	.150	.145	.150	.469	.114	.050		1.916
12	32,000	27,200	9	26.0	1,800	1.000	.046	.189	.103	.128	.150	.463	.140	.050		1.269
13	130,000	40,000	2	10.0	2,800	1.000	.113	.102	.120	.116	.120	.375	.080	.060		1.086
14	170,000	90,000	10	17.5	2,400	1.000	.142	.183	.100	.081	.150	.481	.120	.055		1.312
Average, excluding 2B							.348	.216	.187	.166	.146	.471	.127	.088	.043	1.792
Percent of total cost (average)							19.4	12.1	10.4	9.3	8.1	26.3	7.1	4.9	2.4	100.0
Your mill																

[1] Day shift.
[2] Night shift.
[3] Estimated figures to show how doubling the volume would affect costs.

would therefore need to be calculated for each mill in the light of specific conditions at that mill and current bag prices.

This difference should be considered as a credit to pelleting costs, but since it would vary with the kind of bag and changes in the bag market, and since some mills used the same size bag for both mash and pellets, it is not taken into consideration in this study. Any mill can readily determine what this difference would be for its own operations at any specific time.

Interruptions

Another item not considered in this study, but which can be rather serious, is the possible interruption of other mill operations. If the sacking of mash must be stopped while the pellet supply bins are replenished, this leaves the bagging crew and possibly some of the shipping and warehouse labor idle. If they cannot be shifted readily to other work during such periods, this constitutes a loss which should properly be charged to pelleting.

Many mills have separate mixers or a separate line making the feed for the pellet machines. They would not have this problem. Others can often fill the supply bins during the lunch period or at the end of a shift. In many mills, however, the best of scheduling will not avoid a certain amount of this lost time.

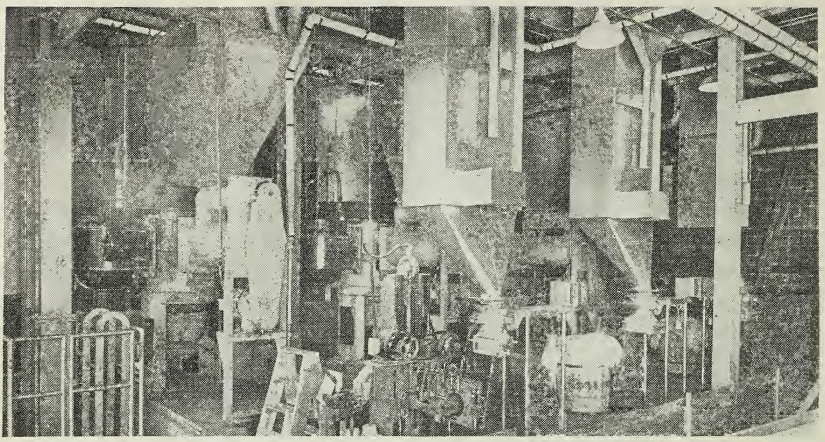
In mills where this was found it varied so with changing conditions that careful records over an extended period would be necessary to determine the extent of this loss. While not included as a cost factor in this study, it appeared to be of sufficient importance in some mills to justify attention by the mill manager and superintendent.

Pelleting Operations at Individual Feed Plants

Table I gives a breakdown of the costs of pelleting at the mills studied, together with a few items of general information about the mills. The day (1A) and night (1B) shifts are shown for mill 1. Two sets of figures are given for mill 2. Under A are given those calculated on the basis of present operations. Estimates to show how doubling the volume would affect costs are given as 2B.[1] This is of interest since the pellet mills were operating only about 3 hours a day.

With considerable hesitation averages are given for the items of cost at the mills studied omitting 2B. It is not known how nearly representative these mills are of the industry and hence how much the averages mean. This is merely a group of case studies and the averages apply only to these mills. Expressed in cents per ton or as a percentage of total cost they may serve as a rough guide in judging performance.

[1] A recent letter from this mill states that pellet volume has already doubled. This facilitated several changes in operating procedure and spread fixed costs over the larger volume so that the effect on total costs per ton has been about as indicated in the table.



A battery of three pellet mills, where the pellets are sacked off direct from the coolers. Stock tanks are in the background.

For the convenience of managers in comparing their operations with costs at these mills a line marked "Your mill" has been provided at the bottom of the table. If costs are broken down on the basis used herein and entered on this line, detailed comparisons will be facilitated.

The first part of table I gives some descriptive data as to size of mill which are of interest in connection with the cost figures. The smallest mill in point of total annual tonnage made 18,000 tons of feed in a year while the largest made 285,000 tons. The annual tonnage of pellets ranged from 3,600 tons to 90,000 tons.

All but two of the mills operated from 1 to 4 pellet mills. One had 9 mills, 1 of which was in use a rather small part of the time, and another had 10.

Pellet production per hour ranged from 1.6 tons to 26 tons. This is not average production nor is it top capacity. It represents normal production when all equipment is in use.

Costs for Feed Mill No. 1

Labor Costs

Labor records were especially complete at this mill and are given here for 1 month in some detail as they bring out some points of interest which cannot be developed from less complete accounts.

The operating record of the day shift is given in table 2. Operating time given is the sum of that for the three pelleting machines, and bags produced is the total for the three machines for the month.

Twenty-three 8-hour days operated during the month is equal to a total of 11,040 minutes. If the three pellet machines, for which data are given in table 2, were operated full time, this would be equivalent to 33,120 minutes for a single pellet

Table 2.—Size of pellets made, time operated, and bags produced by 3 pellet machines in feed mill 1, day shift

Size pellets	Minutes operated	Bags produced	Bags per minute
9/64 inch	5,378	4,836	0.899
12/64 inch	19,838	18,561	.936
5/8 inch	2,268	2,017	.889
Total or average	27,484	25,414	.911

mill. This total was broken down as follows:

	Minutes
Operating	27,484
37 die changes	1,815
Other time shut down	3,199
	32,498
Unaccounted for	622
Total	33,120

Averaging production for the three machines making all sizes of pellets gives 55.5 bags per hour of actual operating time or 46 bags per hour of full time.

The time unaccounted for was presumably in getting started and shutting down at the beginning and end of the shift. The 622 minutes is a total of 27 minutes per day or 9 minutes for each of the pellet machines.

The time consumed in changing dies averaged 49 minutes. The range was from 30 minutes to 1 hour and 40 minutes.

Average production for each of the three pellet machines on the night shift, for which data are given in table 3, was 46.2 bags per hour of actual operating time or 40.5 bags per hour of full time.

The night shift operated 22 days during this period. This is equal to 31,680 minutes full time total for the three machines as measured in the single mill equivalent. This breaks down as follows:

	Minutes
Operating	28,804
25 die changes	1,108
Other time shut down	565
	30,477
Unaccounted for	1,203
Full time	31,680

Table 3.—Size of pellets made, time operated, and bags produced by 3 pellet machines in feed mill 1, night shift

Size pellets	Minutes operated	Bags produced	Bags per minute
9/64 inch	8,396	6,396	0.762
12/64 inch	18,622	14,367	.772
5/8 inch	1,786	1,416	.793
Total or average	28,804	22,179	.770

Table 4.—Size of pellets made, time operated, and bags produced by 3 pellet machines in feed mill 1, day and night shifts

Size pellets	Minutes operated	Bags produced	Bags per minute
9/64 inch	13,774	11,232	0.792
12/64 inch	38,460	32,928	.856
5/8 inch	4,054	3,433	.847
Total or average	56,288	47,593	.840

Unaccounted time would be a total of 54.7 minutes per day or 18.2 minutes for each of the mills. Die changes averaged 44.3 minutes.

The combined record of the day and night shifts is shown in table 4.

Altogether, the day and night shifts worked a total of 64,800 minutes for the month. This time was divided as follows:

	Minutes
Operating	56,288
62 die changes	2,923
Other time shut down	3,764
	62,975
Unaccounted for	1,825
Full time	64,800

Operating data for the three mills are given below;

Total bags	47,593
Bags per hour, operating time	50.73
Bags per hour, full time	44.07
	Minutes
Average die change	47.15
Other time shut down, total per day	83.64
Or per machine, each shift	13.95
Unaccounted time, total per day	40.55
Or per machine, each shift	6.76
Operating time was (percent of full time)	86.86

At this mill size of pellet made had little effect on hourly production. Although other managers did not have production figures on different size pellets, they all said that production was much less when making the small pellets. A consensus of their ideas would probably be that if production of 11/64- or 13/64-inch pellets for laying hens were taken as a standard, production of 8/64- inch or 9/64-inch chick pellets would be about half as great while that of 3/8-inch pellets or larger would be from 25 percent to 40 percent greater.

The pellet crew and their wage rates were as follows:

Item	Wage rate	
	Day	Night
1 Pellet mill operator	$1.375	$1.445
2 Packers	2.650	2.790
1 Sewing machine operator	1.325	1.395
1 Handler	1.325	1.395
1 Supervisor (half time)	.750	.750
Total for crew, per hour	7.425	7.775

Averaging the day and night shifts the wage cost of these crews was $7.60 per hour. At the average rate of 44.07 bags per hour per machine the direct labor cost was $0.0575 per bag or $1.150 per ton.

A large part of this cost is due to the fact that the packing rate is low. While these crews pack 132.21 bags per hour (44.07 from each of three machines) three-man crews operating on the mixed feed lines pack and sew an average of 12½ bags per minute or 750 bags per hour. Wage rates are the same. It therefore costs $0.00543 per bag to pack and sew on the mash line or $0.109 per ton.

The study attempts to present the additional cost of pelleted feeds as compared with nonpelleted mixed feeds. Under the set-up in use, packing the pelleted feeds costs much more than packing other feeds and this fact should be considered in arriving at the difference in cost.

Therefore, the labor cost of $1.150 per ton for making and packing pelleted feeds is credited with the $0.109 per ton cost of packing other feeds. Thus pelleting adds $1.041 to the labor cost per ton.

From the mash lines the feed goes directly on conveyor belts to cars or storage. From the pellet sewing machine the feed goes onto a table where a man sorts and places it as required. This operation is therefore also considered as an additional cost of the pelleting and is included above.

Other Costs

Depreciation on buildings is calculated at 3 percent straight line and on equipment at 10 percent. Power cost is determined by applying to the power bill the ratio which the horsepower of electric motors used in the entire pelleting operation bears to total connected horsepower at the mill. This method may give a cost of power for pelleting slightly lower than it should be since the pellet motors are in operation a larger part of the time than many other motors in the mill. Steam cost is estimated. Die cost is an accumulated figure for the 8 years the mill has been in operation. The full amount of general and administrative expense for the entire mill operation was $0.62 per ton. Buying, billing, and most of the accounting and general expenses would apply equally to pelleted or unpelleted feeds. Some management and general expenses would, however, apply to the pelleting operation itself. It is believed that 10 percent of the over-all figure is equitable for this.

Pelleting equipment is located at one end of the sacked ingredient warehouse. The mixed feed is brought by a screw conveyor from the mixing lines to 12 tanks, each of which has a capacity of about 12½ tons. From these tanks there are two screw conveyors which take the feed to magnetic separators and then to the pellet mills. Feed from any storage tank can be brought to any of the mills. All mills can pellet the same formula at one time or two can be used on one formula and one on any other. The conveyors carry a full and continuous supply to the mills and any surplus is carried back to the proper storage tank. Each mill is equipped with an ammeter so it can be kept operating at full capacity. From the mills the pellets are elevated to

shakers where the fines are removed and returned to the mill. From the shakers the pellets go to coolers which are kept full by electrical controls. The only surge bins following these coolers are simply extensions of the cooler shell which hold only a few bags. There are three automatic bagging scales, one for each pellet mill. Two men are detailed to operate these packers. A floor belt takes the bags to a fixed sewing machine. From there a short belt carries them to a shoulder high bench. There are usually two formulas or sizes coming through. A man at this bench sorts and places the bags on a conveyor belt for car loading, on hand trucks for truck loading or storage, or piles them on the floor nearby for temporary holding.

Labor makes up a much larger proportion of total pelleting cost at this mill than at any of the others. It is believed that, if instead of bagging off direct from the coolers, suitable holding bins were provided, one man could weigh, sack, sew, and place on loading belt or hand trucks the output of the three pellet mills. This averages only 132 bags per hour or 2.1 bags per minute, which is still less than half as much as one man can do readily.

If this change could be made the 5½-man pellet crew would be reduced to 2½ men. This would reduce labor cost per ton from $1.041 to $0.532. Additional costs for space and equipment would of course, be involved and these would have to be balanced against the saving in labor.

Costs for Feed Mill No. 2

Labor Costs

Mill 2 is a modern line-mix plant completed since the war. It has a battery of four pellet machines. There are four bins of 15 tons capacity each, used for holding pellet stock and finished pellets. Two or three of these are filled during the packing crew's lunch hour and at the end of the day shift so there is little idle time connected with the operation. One filling of the bins is sufficient for a day's production of pellets during most of the year. Pellets are made during the night shift and left in the holding bins.

The scratch line usually operates only a few hours a day. Pellets are run over this packing unit by the same crew with a minimum of disruption.

The wage rate for the pellet mill operator is $1.450 per hour. The work week is 45 hours. Adjusting for overtime and indirect labor costs the average hourly rate is $1.761. While all four pellet machines are customarily operated at the same time, often fewer will be running so that average production is 7.5 tons per hour. On this basis direct labor cost is $0.443 per ton.

A three-man crew packing from the mash line runs 12 bags per minute. A two-man crew packing pellets on the scratch feed unit runs 6 bags per minute. This makes the cost of packing pellets $0.038 more per ton than for mash and this is added to the labor cost on pellets making the total $0.481.

Two kinds of feed can be pelleted at the same time. Two sizes are

Feed mills usually require much warehouse space even though most of the ingredients are received and stored in bulk.

made; $\frac{9}{64}$ and $\frac{13}{64}$. The volume of the smaller size is not great and is confined largely to the spring chick starting season.

Pellets are priced at $2 per ton over mash.

When the pellet mills are not running the operator works at the molasses mixer, with the feeder man on the production line, or at other jobs about the mill.

Approximately 75 percent of the pellets at this mill are loaded direct onto cars or trucks, leaving 25 percent to be placed in the warehouse. On regular feeds only about 5 percent must be stopped in the warehouse. Including the cost of warehousing this larger proportion of pellets as explained on page 9 adds 20 cents per ton to the total cost of pelleting.

Other Costs

At this mill the largest item in pelleting cost is the charge for interest and depreciation on equipment, since the pellet equipment is in operation only 3 or 4 hours per day. With the steadily increasing demand for pellets it is probable that within a few years pellet volume will be doubled. It is of interest to see what effect this would have on costs, as estimated under 2B in table 1, page 10. Labor per ton is reduced about 10 percent because all four mills would be running a greater portion of the time. Power and steam cost would show a small reduction. Die cost would remain the same. Maintenance would be slightly lower. Since depreciation and building occupancy are annual charges the amount per ton for these items would be cut in half. A larger amount but a smaller percentage of the output would probably have to be warehoused. Making these changes, it appears that doubling the pellet volume would reduce costs per ton from $2.433 to $1.714.

As stated in the footnote on page 11, pellet volume at this mill has about doubled since the data were obtained and the effect on costs have been about as indicated above.

Costs High at Mills 1 and 2 for Different Reasons

It is interesting to compare mills 1 and 2. Costs at mill 1 are high largely because of the heavy labor use. This in turn appears to be caused largely by under-equipment in not having holding bins after the pellet mills but packing direct from the coolers. Costs at mill 2 are high because of over-equipment for the volume now manufactured, which results in high charges per ton for depreciation on equipment and for building occupancy. These two cases illustrate the necessity of balance if costs are to be kept low. Of course, in each case plans for the future may make it more economical in the long run to operate this way temporarily than to make changes now which might be used only a short time.

Costs for Feed Mill No. 3

Labor Costs

Mill 3 is a batch-mix feed mill with two pellet machines. Only the one size, $^{13}/_{64}$ inch, pellets are made. One man operates the pellet machines and bags the pellets. While nearly all the regular feed goes direct from the sewing machine onto the conveyor belt for loading into cars, pellets go down a chute from the sewing machine and are stacked in the warehouse and then placed on the conveyor belt as needed. This requires a man on the warehouse floor when the pellet machines are operating. Pellet stock is held in a 4-ton bin and a 6-ton bin. These are filled by the night crew for use during the day but it is necessary to refill the bins and while this is being done bagging the mash is interrupted.

The mill operates a 45-hour week with a small night shift also. The base wage rate is $0.950 per hour which with overtime and other labor charges amounts to $1.153 per hour. With two men producing 4 tons of pellets per hour this makes a direct labor charge of $0.576 per ton. Mash bagging cost of $0.108 per ton credited to this leaves $0.468 per ton.

Other Costs

An average electricity cost of $0.016 per kilowatt-hour results in the cost for power per ton of $0.186. Steam cost is that determined by the mill after a careful study. At that time steam for pelleting was obtained from a boiler used for no other purpose. A larger boiler has since been installed which furnishes steam for heat, pelleting, and other uses so that the cost per unit is probably somewhat lower now.

Costs for Feed Mill No. 4

Labor Costs

Mill 4 is a batch-mix mill making about 50,000 tons of feed a year, of which 9,200 tons were pelleted last year. It has four pellet machines with a 6-ton holding bin ahead of each mill. The mill operates a 55-hour week. The hourly

wage rate is $1.050, which with overtime and other charges makes the average cost $1.372 per hour. One man keeps the four mills operating. With additional help for changing dies this makes the direct labor cost per ton $0.251.

Other Costs

A 50-horsepower boiler provides ample steam at 45 pounds pressure for the four mills. Crumbles are made from $^{8}/_{64}$-inch pellets. Each mill will make 45 bags per hour of this size pellet but with the fines produced from crushing to make crumbles, the production is reduced to about 30 bags per hour. About 20 percent of the pellet volume given above is crumbles.

Only about 25 percent of the general feed line is loaded direct from the packers and in the case of pellets, only about 10 percent. This difference in the percentage stopped in the warehouse adds $0.150 per ton to the cost of pellets. The packing set-up for pellets operates at about the same rate as that for mash so there is no additional cost involved here.

Costs for Feed Mill No. 5

Labor Costs

Mill 5 is a batch-mix mill having a total volume of manufactured feed of 18,000 tons per year of which 3,600 tons are pelleted. One pellet machine is used. Regular operation is on a 44-hour week basis.

This mill is in a dry climate and satisfactory cooling of the pellets is obtained simply from a fan blowing on the pellets as they go over the shaker screen. Bins before and after the pellet mill hold 4 tons each. One man operates the pellet mill and barley roll and packs from both. He packs and trucks to storage at the rate of three bags per minute.

The base wage rate of $1.015 figures out with 4 hours overtime per week and indirect charges at $1.219 per hour. On this basis, direct labor at the pellet mills costs $0.250 per ton. Mash packing labor cost is about $0.100 per ton so that the labor on pellets over and above that on mash is only $0.150 per ton.

Other Costs

Electric current costs an average of $0.0216 per kilowatt-hour and this makes power cost per ton $0.263.

While this is a small operation, labor is used effectively and none of the expense items are high. The total cost of $1.351 per ton over those for mash is consequently very low. The price differential between mash and pellets is $1.40 per ton.

Costs for Feed Mill No. 6

Mill 6 has two late model pellet machines. Total annual feed production is 38,000 tons of which 5,000 tons are pellets. Only one size die is used, $^{10}/_{64}$ inch. This mill does not have pellet coolers but has a vacuum system carrying the pellets approximately 150 feet to a bin from which they are sacked off. This vacuum system appears to cool the pellets satisfactorily but limits production as it will not handle full capacity of the two mills.

Labor Costs

The mill works a 45-hour week with a small crew at night. The wage rate of $1.150 for mixer men, with overtime and related charges gives a labor charge of $1.449 per hour. All feed is hand-trucked and tiered in the warehouse so costs here are the same for mash and pellets. Average cost for power is $0.015 per kilowatt hour.

There is a 30 horse power gas fired boiler used mainly for steam for the pellets although some is also used for rolling barley and some for space heating. There is a separate hammer mill, mixer, and related equipment for making pellet stock. The man operating the mixer gives whatever attention is needed to the pellet mills. Efficiency of this mixing appears to be about on a par with other mixing in the mill.

This mill used a smaller bag for pellets than for mash so that on the basis of all new bags, there would be a saving on pellets of about 25 cents per ton for this reason. This is not deducted in table 1.

Costs for Feed Mill No. 7

Mill 7 is a batch-mix mill operating two new model pellet mills and having two older ones which are kept on a standby basis. They make only $^{10}/_{64}$ inch pellets and the two mills will average together 120 bags of these per hour. Total feed production is 62,000 tons per year including 11,000 tons of pellets.

Labor Costs

There are separate mixing and packing units for each of the new mills and one for the two old mills. With this set-up it was necessary to consider the entire operation covering mixing, weighing, bagging, sewing, and hand trucking to warehouse or trucks to determine the difference in labor involved in making mash and pellets. One mash unit used 5 men and turned out 175 bags per hour. A second mash unit used 4 men and turned out 140 bags per hour. These would be at the rate of 35 bags per man-hour. The pellet units each used 2 men and produced 60 bags per hour or 30 bags per man-hour. The wage rate was $1.575 per hour. There was no regular overtime but adding 15 percent for payroll taxes, vacation, etc., the cost per hour was $1.811. This figures out to a difference in labor cost on these operations of $0.174 per ton between mash and pellets.

Other Costs

The life of the dies was estimated at only 750 tons but it was explained that dies were not used until they began to break down but were discarded as soon as the size of pellets began to be noticeably larger. This of course runs the die cost per ton up considerably.

Steam is supplied by two boilers. One of these is 10 horsepower and the other 15 horsepower. They are used alternately for periods of 2 or 3 weeks. The 10 horsepower boiler will not supply enough steam at times when the pellet mills are running steadily.

Costs for Feed Mill No. 8

Mill 8 is a batch-mix mill making 30,000 tons of feed a year of which

about 8,000 tons are pellets. It has two late-type pellet mills. Full capacity on these mills is about 100 bags per hour but they are operated at about 60 bags per hour. One mill was run about 8 hours a day while the second was usually run only about 2 hours a day at the time the study was made. The batch mixers in the mill are 3-ton capacity and holding bins before and after the pellet mills hold 4 tons each. An $^{8}/_{64}$-inch die is used for chick feed and $^{12}/_{64}$-inch for laying mash. The mill had just started making crumbles and would probably replace the $^{8}/_{64}$-inch pellets with these. Crushing the pellets with rolls having a difference of 150 revolutions per minute in speed was producing 28 percent fines. It was planned to reduce the difference in speed to 35 revolutions per minute hoping to reduce the proportion of fines. This mill and several others did not screen the fines from the crumbles but sold them just as they came from the rolls. Poultry growers there did not object to a reasonable percentage of fines, while in some parts of the country every effort is made to remove all the fine material from crumbles.

Labor Costs

Hourly wage rate of $1.350 increased by 15 percent for other labor costs gives $1.553 as labor costs per man-hour. The operator-packer alternated between this and other work and direct labor cost was only $0.125 per ton.

Other Costs

The life of the dies was estimated at 600 tons which is, of course, very low. With the high cost of the large dies used on the later type mills die cost reaches the very high figure of 50 cents per ton. [1]

The mill makes a price differential for pellets of $1.40 per ton over mash or in the case of crumbles $2.

Costs at Feed Mill No. 9

Mill 9 is a recently completed line-mix mill making about 140,000 tons of feed annually of which 13,600 tons are pellets. They are made in $^{8}/_{64}$- and $^{12}/_{64}$-inch size. Crumbles are not screened. There are four pellet machines, two of which are the late type.

There is storage for 45 tons of mash ahead of the mills and for 60 tons of pellets. A 100-horsepower boiler furnishes steam for pelleting, rolling barley, and space heating.

Labor Costs

The wage rate of $1.55 per hour is increased by 10 percent to $1.705 per hour as this mill finds this covers the extra labor charges. One man operates the four pellet mills. Two men pack mash at the rate of 18 tons per hour and two men pack pellets at the rate of 15 tons per hour. This adds $0.038 per ton to the charges made against pellet manufacture.

The price differentials made at this mill are $2 per ton over mash for laying size pellets ($^{12}/_{64}$), $3 for chick pellets ($^{8}/_{64}$), $3 for crumbles

[1] Since these data were obtained the pellet mill operator has been changed. The former one did not like to see steam escaping from the pellet mill and never used enough. The new operator studies his production and uses more steam, with the result that die life has been nearly doubled and production increased.

and $4 for a small $^{6}/_{64}$ pellet of which only a few are now made.

Costs at Feed Mill No. 10

Mill 10 is an older plant operating one pellet machine. Total feed production is about 50,000 tons per year, of which 5,000 tons are pellets. Pellets are made in four sizes: $^{8}/_{64}$-inch pellets for starting chicks, $^{12}/_{64}$-inch laying hen pellets, ½-inch fox pellets and ¾-inch cattle pellets, but the bulk of production is in laying hen pellets. Records did not show the comparative production per hour for the different sized pellets.

Labor Costs

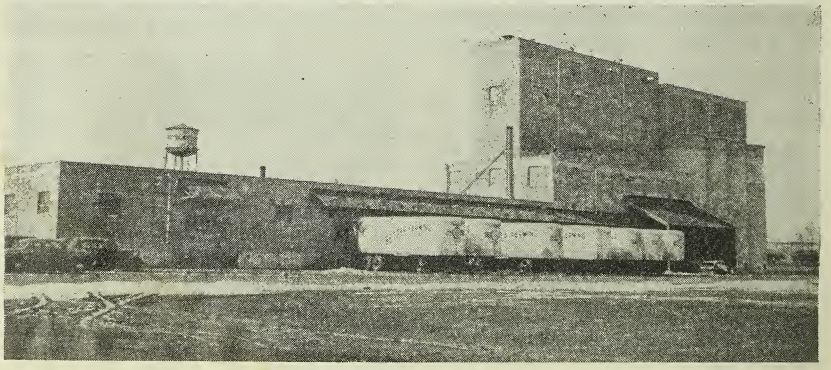
The pellet machine operator is paid $1.200 per hour and works a 44-hour week. Power cost averaged $0.015 per kilowatt hour. One man operates the pellet mill and sacks the pellets. Production averages about 50 bags per hour. This makes a direct labor cost of $0.577 per ton. Adding $0.015 for die changes gives a total of $0.592 per ton. Two men pack mash at the rate of 12 tons per hour or a labor cost of $0.241 per ton. Subtracting this from $0. 592 leaves $0. 351 per ton chargeable to pelleting. Die life is estimated at about 2,000 tons. Die changes are made about once a week and take two men about a half hour.

Other Costs

It is estimated that 50 percent of the pellets must be warehoused temporarily while all but 20 percent of the mash is loaded direct. This adds $0.300 per ton to the cost of pelleting.

Costs at Feed Mill No. 11

Mill 11 was making about 40,000 tons of feed a year of which 4,000 tons were pellets. One new type pellet machine was in operation. At the time, only a 7-horsepower boiler was available for steam and this gave an inadequate supply at low pressure. Plans were being



Semitrailers left at the dock for loading while the tractors have others out on the route permit most of the loading to be done direct from production and thus avoid the costs of stopping feed in the warehouse.

made to install a larger boiler. Production was only 3 tons per hour and the manager was convinced that this was largely caused by the steam situation. Mash formulas included 2½ percent molasses.

Holding bins for pellet stock have a capacity of 15 tons and the pellet bin about 3½ tons.

Labor Costs

The wage rate is $1.200 per hour. Pellets are made at night and the small night shift receives 9 hours' pay for 8 hours' work. Adding 15 percent makes the total $1.553 per hour. Labor costs per ton of pellets, including $0.075 for die changing, amounts to $0.589. Crediting mash bagging labor cost of $0.136 leaves a net charge to pellets of $0.453 per ton.

Other Costs

Power rates are very high at this point. Average cost per kilowatt-hour was $0.028, making power cost per ton $0.385. Die life was estimated at 2,000 tons. Cost of dies to make laying hen-sized pellets was $290, making cost per ton $0.145. The pellet installation cost $15,000 so depreciation charge was $0.375 per ton. Pelleting used 650 square feet of space on three different floors. Building cost $7 per square foot. At 10 percent a year or $0.700 per square foot the building occupancy charge was $455 or $0.114 per ton.

Pellet volume was increasing rather rapidly. These figures are based on production at the time data were obtained and costs will be lowered as volume increases. The price differential for pellets over mash was $2 per ton but complaints were being received from a few members that competitors had reduced their charge to $1.50.

Costs at Feed Mill No. 12

Mill 12 made 32,000 tons of feed last year of which the very large proportion of 27,200 were pelleted. There is a battery of nine pellet machines, one of which is held in reserve for starter pellets and used only a little. Production is quite seasonal. Each mill makes about 65 bags per hour or a total of 26 tons for the eight mills.

One man operates the pellet mills, and sacking is done at the same rate as for mash. Over half the pellets are now delivered in bulk. This is reflected in a price differential between sacked and bulk feed of $4 per ton. Allowance for bags returned was then 14 cents each so that net difference in price in favor of bulk feed if all bags were returned in good condition was $1.20 per ton. The price for pellets was $2 per ton higher than for mash.

Labor Costs

The mill works a straight 40-hour week. The wage rate was $1 an hour and at this mill additional benefits cost 20 percent so that labor cost per hour was $1.20. Since there was no additional charge to be made for sacking differential or extra warehousing, the labor cost was only $0.046 per ton.

Other Costs

With power cost of $0.020 per kilowatt-hour, the cost per ton was

Trucks like this haul feed pellets direct from co-op mill to feeding hoppers on the farm.

$0.189. Steam was provided by two 30 horsepower boilers. Fuel cost $2,000 for the year while labor and other charges amounted to $800, making the cost of steam $0.103 per ton of pellets.

Average die life of 1,800 tons with dies costing $230 makes die cost $0.128 per ton. Repairs and maintenance were estimated at $0.150 per ton. The pellet equipment cost approximately $100,000 installed. Depreciation at 10 percent a year would be at the rate of $0.370 per ton. Pelleting used 20 percent of the space in a mill which cost $190,000. Charging 10 percent a year on this adds $0.140 per ton to pelleting cost.

Costs at Feed Mill No. 13

Mill 13 made 130,000 tons of feed a year, of which 40,000 tons were pellets. Two new type pellet machines turned out 100 bags each per hour regularly. One man spent about half his time on these mills at a cost of $0.063 per ton. An average of 6 die changes a week added $0.050, making the total $0.113 per ton. Pellets were bagged at the same rate as mash.

One mixer works constantly on feeds for pelleting so that surge bins of 3-ton capacity ahead of the pellet mills and after the coolers meet the needs of this operation.

The bulk of production here was in $^{13}/_{64}$-inch laying pellets and $^{3}/_{8}$-inch hog supplement pellets. Each size was produced at about the same rate. The mill foreman believed the large percentage of animal protein in the hog supplement was the reason these large pellets did not run through any faster than the poultry-laying pellets that were only half the size.

Labor Costs

The mill operates two shifts of 48 hours per week and the pellet mills operate constantly to meet the demand. This keeps some of the cost items rather low.

One man sacks pellets from the automatic scale and sews at the rate of four bags per minute. At this rate he empties the surge bin occasionally and must shut down. He uses this time to bring bags from storage, to clean up around his station, or for other purposes.

Other Costs

Electric power cost $0.0116 per kilowatt-hour or $0.102 per ton. Two 125 horsepower boilers provided steam at 80 pounds pressure. The life of the dies was 2,800 tons but since dies for laying hen sized pellets cost $324, the cost per ton was $0.116.

This mill was using bags cut 44 inches for pellets and 46 inches for mash at a difference in price of $13.80 per 1,000. This would be a credit to pelleting of $0.276 per ton.

Costs for Feed Mill No. 14

Labor Costs

Mill 14 is a line-mix mill making 170,000 tons of feed a year of which 90,000 tons are pelleted. There is a battery of 10 pellet machines, each of which averages 35 bags per hour. The wage rate is $1 per hour and the work week is 48 hours. Adding overtime premium and 15 percent for other labor costs gives $1.245 as the cost per man-hour.

One man is at the pellet mills full time and another upstairs keeps each machine supplied with mash at all times. These men also change dies as needed. This makes labor cost per ton $0.142.

Other Costs

Power at $0.0116 per kilowatt-hour costs $0.183 per ton. Dies cost $195 and an average life of 2,400 tons makes dies cost $0.081 per ton. Two sizes of pellets are made—$^{12}/_{64}$ inch and $^{3}/_{8}$ inch. The laying hen-size pellets are crushed for chicks and in making these crumbles 20 percent to 25 percent goes back to the mills as fines. The average production per mill of 35 bags per hour includes this re-run of fines.

Packing and warehousing are on the same basis as mash so no extra costs are involved.

It was noticed at both mills 13 and 14 that employees were especially interested in their work. They were not tied down by myriad rules and shifted to other jobs if their own work was interrupted.

CONCLUSIONS

In view of the uncertain economic outlook during the national emergency, plans for expanding pelleting operations should take into account several factors. These factors include the availability of equipment, and the effect of pelleting on the efficient use of feed, plant personnel, and farm labor.

The data presented were obtained

from 14 cooperative feed mills. They may or may not be representatives of the industry. However, it is believed the material given will help all feed mills spot some of their points of high and low costs. Table 1 on page 10 shows the total extra costs charged to pelleting range from a low of $1.086 per ton of feed to a high of $2.568 per ton. The mills which showed both extremes in costs were producing relatively large quantities of pellets per year. The high-cost mill ranked third in production and the low-cost mill ranked second. The average extra cost of pellets for all 14 mills was $1.792 per ton.

Many factors, of course, enter into the cost of pelleting feed. They include such costs as wage rates, labor efficiency, power, steam costs, the life of the dies used to make pellets, repairs, maintenance, interest, depreciation, building costs, general and administrative costs, and in some cases, extra warehousing.

These different elements of cost vary widely at different mills. If some costs are low, this very fact may cause other costs to be high. For example, where a large battery of pellet machines is operated so that one man can give full time to attending them, direct labor costs may be kept rather low. However, unless the machines are run at capacity, equipment costs, may be high. On the other hand, if a man can attend one or two mills and also carry on other work effectively, direct labor costs can be kept low in a small mill.

An intelligent pellet mill operator who will study his production can greatly affect volume. Consequently the management should see that such a man is detailed to this position and encouraged to keep production high.

Since mill costs accumulate on a bag of feed until it is loaded for shipment, packing and warehouse operations must be kept on an efficient basis or costs will mount.

Pelleting equipment is expensive and must be kept in use at near capacity rates if unit costs are to be kept down. On the other hand, if adequate work bins are not provided, labor costs can easily become excessive.

With the steadily increasing demand for pellets, this part of mill operation is becoming of increasing importance. Smart management will see that the operation is conducted efficiently.

The volume involved and the differences in costs indicate that this manufacturing process merits the careful attention of management.

Individual expense items may be reduced or held down with the result that some other items are increased disproportionately. Each item must be considered in its relation to over-all costs.

One of the largest expense items, subject to the greatest variation, was labor. The point at which labor inefficiency was most frequently found was in the bagging operation. Some mills which were quite efficient in packing mash did poorly in packing pellets.

Some mills were under-equipped for pelleting while others were over-equipped. Either condition increases costs. Importance of balance was forcefully demonstrated.

Generally several pellet machines can be operated more economically than one or two. However, a small number of machines can be operated at low cost if holding bins are adequate and labor can be readily shifted to other work while these bins are being filled.

Because of the relatively high cost of equipment used, two- or even three-shift operation appears to be most economical. Where pellet machines are operated only a few hours a day it is difficult to achieve low costs.

Because of the rapidly increasing demand for pellets, high-cost operation does not necessarily indicate poor management. It may be cheaper to over-build, knowing that operating costs will be high for a while. Likewise it may be better to operate under-equipped for some time rather than make minor changes which will take care of increasing volume only temporarily.

U. S. GOVERNMENT PRINTING OFFICE: 1951

Other Publications Available

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